published in the German book: Winkler, H.: **Prozessieren** [Processing].
Die dritte, vernachlässigte Medienfunktion.
Paderborn: Fink: 2015, [Chapter 3.3], pp. 277-296,
http://homepages.uni-paderborn.de/winkler/Winkler--Prozessieren.pdf.

English preprint / Web publication 2023:
http://homepages.uni-paderborn.de/winkler/Winkler--Processing--Ch-3-3.pdf

Hartmut Winkler

The Computer – A Child of Telegraphy

1. Intro

For about 40 years, computers were stand-alone machines, enclosed in their cases, monads, a tool. Then came the cables, the ARPA and the Internet, and computers began to ‘communicate’; and since then the computer has been a medium.

This is more or less how it reads in the vast majority of accounts of media history. Possibly, however, this view is wrong. For one thing, the computer has always been a medium, insofar as it manipulates *symbols*, not matter and energy. But above all for a second and rather unsuspected reason: As I will show in the following, the computer itself is a legitimate and direct offspring of telegraphy. The logic of telegraphy has inscribed itself into its inner logic and has determined its construction from the ground up. Accordingly, my proposal is to reverse this perspective: It is not stand-alone computers that make contact with each other, but with the cabling the computer – speaking riskily in terms of ‘media-ontology’ – instead circles back to itself, or at least to its own origins.

Whether the outlined view is tenable makes a difference not only for the positioning of computers in media history. At which point what kind of media-historical lines intersect is a problem for theory as well, if theory is to decipher the internal logic of the individual media and their precarious interrelation. The outlined thesis promises much on this front: Since telegraphy is a macrostructure distributed over large geographical spaces, while the computer is a microstructure, a local arrangement of hardware components enclosed in a case, the thesis seems capable of building an unsuspected bridge between macro and micro. And if telegraphy is designated as a machine for *transmitting* data, but computers are about *processing*, a second unsuspected bridge emerges, now between two central media functions. From a theoretical standpoint, I think this is interesting.

In the following, the thesis will be made plausible step by step, both with regard to certain technical modes of operation and in a broader historical perspective. I think that my thesis can even contribute something to the history of telegraphy. As comprehensively as it has been reviewed,[1] it undeniably has blind spots, which, however, only become clear when, starting from the experience of the computer, one once again inquires backwards into the space of telegraphy.

[1] The historiography ranges from period accounts to the present; examples include:
- Schellen, Heinrich: Der elektromagnetische Telegraph in den Hauptstadien seiner Entwicklung und in seiner gegenwärtigen Ausbildung und Anwendung. Braunschweig: Vieweg 1854, p. 149; available on Google Books: http://books.google.com/books?id=XecOAAAAYAAJ.
- Knies, Karl: Der Telegraph als Verkehrsmittel. Über den Nachrichtenverkehr überhaupt [1857]. Munich 1996.
- Zetzsche, Karl Eduard: Geschichte der elektrischen Telegraphie. Charleston, SC: Nabu Press 2010 (EV: 1877).
- Beauchamp, Ken: A History of Telegraphy: Its Technology and Applications. London 2001.
- Standage, Tom: The Victorian Internet. The Remarkable Story of the Telegraph and the Nineteenth Century’s On-line Pioneers. New York: Berkeley 1998.
In addition, some texts use telegraphy as a stimulus for theoretical thought:

2. internal telegraphy

As a first step, I would like to come back to certain points I worked out in the chapter 'What does a processor do'.[2] One of the conclusions there was that one has to understand the processes in the computer itself as a kind of 'telegraphy'.

Firstly, within the computer, data is constantly being sent from A to B, from the hard disk to the processor, from there to the screen or to one of the ports... Every module in the computer has an *address* that allows data to be passed to it; the main memory itself is divided into 'addresses', every data block is, like a postal package, provided with an address, and the processor spends a good part of its time not managing data, but addresses. All this is a logic of the post, of delivery, of transmission. And since it is the transmission of writing, it is a logic of telegraphy. This first parallel would hardly be disputable; but does it really get to the heart of how computers work?

Surprisingly, the same is true on a more fundamental level for the processor itself. For in the micrology of the processor, this was also a result of my consideration above, data is not actually 'processed', i.e. transformed or changed in its substance, but all processes are dissolved into individual steps of *writing* and *reading*.

Processors consist of huge networks of switches that are set anew for each processing step and whose logical structure determines what, once the work cycle is completed, will be present at the output as the result of the calculation. During the work cycle itself, the data is passed – quasi 'live' – through the switching networks; again a process of transmission. Like the transmission across geographical distance, it takes time.

And it is volatile, or better: it *would be* volatile, if the destination point of the transfer were not always a *memory* into which the result is written. And in the same way, data is read from memories. 'Writing', then, connects a process of transmission with the inscription in a memory; 'reading' connects the seeking and reading of a memory with a transmission.

The vocabulary already indicates: Telegraphy – systematically considered – does exactly the same. Here, too, it is a matter of writing and reading, transmitting and storing; for telegraphy, too, is by no means a technique of transmission alone, but is necessarily tied to the existence of storage. At the beginning of its development, it was human operators who mediated between transmission and storage; telegraph operators read a paper document (i.e., a memory) to feed the transmission apparatus with texts, and at the destination other operators wrote down the messages. Both functions were soon taken over by machinery: In 1836, the telegraph was coupled with a writing mechanism that recorded the incoming signal on a paper tape;[3] starting in 1858, punched tape was used to mechanize the input as well.[4]

So the second parallel would be this oscillation between storing and transmitting. It is important to note here that both cases involve purely mechanical processes. Even if in the case of telegraphy humans are involved, no dimension is addressed that would be strictly bound to 'humans' and their specific abilities; telegraphy and computer work only with signals, even if these are recoded several times; understanding, meaning, 'semantics' or the like do not initially play a role.

- Peters, John: Speaking into the Air. A History of the Idea of Communication. Chicago, IL/London: University of Chicago Press 2000 (EV: 1999) or
- Czitrom, Daniel J.: Media and the American Mind. From Morse to McLuhan. Chapel Hill, NC: University of North Carolina Press 1984.

Excellent also the keyword 'Telegraph' in: Lueger, Otto (ed.): Lexikon der gesamten Technik. Stuttgart/Leipzig: DVA 1904; available online via: http://www.zeno.org/Lueger-1904/A/Telegraph+%5B1%5D, 12/1/2010.

[2] Winkler, H.: Prozessieren. Die dritte, vernachlässigte Medienfunktion [Chapter 3.2]. Paderborn: Fink: 2015, pp. 255-276.

[3] The most famous typewriter telegraph was developed by Morse.

[4] Charles Wheatstone (o. A.: Morse telegraph page DK5KE, http://www.qsl.net/dk5ke/telegraf.html).

Another parallel is the fact that in both cases the signals are processed in a strictly linear way. In the case of telegraphy, this is due to the internal logic of transmission; and on several levels: ‘Linear’, first of all, are the cables themselves, which cut through the landscape. Their length is determined by the geographical distances they bridge. To save copper, they are made as thin as technically possible;[5] cables (and traffic routes, canals, channels) are always ‘narrow’.

And ‘linear’ is secondly the sequence of the signs. The model here is writing, which arranges its signs in lines, and oral language, which arranges the articulated sounds along the time axis. Flusser has worked out most clearly that this linearity is a particularly strict system of order.[6]

Technically, however, it is quite difficult to transmit characters via a cable, because the 26 characters of the alphabet still demand a certain ‘width’ of the channel. Here, media history has found several possibilities: One can use different signals, i.e. high pitch for an ‘E’ and low pitch for an ‘M’;[7] which has the disadvantage that the transmitting and receiving technology must be able to identify these different signals reliably. Or one can use several channels in parallel to transmit a single character,[8] which is not very advisable in terms of resources. Classical telegraphy has therefore developed a much more radical solution. It gets by with only one cable and only one type of signal.

The technical facts are well known: The most important invention concerning telegraphy was the Morse code of 1844, because it slimmed down the signals to the ‘narrowest’ variant; ‘power on’ and ‘power off’; an anticipation of the digital, even if Morse knows three characters (‘long’, ‘short’ and ‘pause’), and not only two characters like the computer. The problem is that even a single character of written language must be broken down into a *sequence of pulses* that are sent *successively* through the cable. Thus, a ‘Q’ in Morse code is encoded in four characters – long, long, short, long – and the representation of a letter in the computer requires 8 bits. So in a sense, what is not available in terms of the width of the channel is pulled into temporal length. *Space is recoded into time.*[9]

Obviously, then, it is the logic of transmission itself that forces a linear arrangement of the signs, and more precisely: a specific compulsion to *economy*. The signs nestle up against the cables, at the price that the space saved in successive transmissions must be paid for with *time.*

In the case of the computer, strict linearity is adopted in the so-called ‘Von Neumann’ architecture. The fact that a computer proceeds step by step, and – at least on the level of principle – executes only a single step at any given time,[10] translates the logic of linearity into the operational. And here, too, the price is the time that passes. All this should make clear that the processes inside the computer resemble telegraphy. Taken by itself, however, the argument could prove little more than a structural analogy between macro and micro. To show that the connections are in fact broader, it makes sense now to move from micro to macro; from computer to telegraphy.

---

[5] The thinner the cable, the greater their attenuation due to increased electrical resistance.

[6] Flusser, Vilém: Into the universe of technical images [1985]. Minneapolis: University of Minnesota Press 2011, pp. 5ff.

[7] An example would be the dial tone used in the analog telephone network, which assigns different pitches to each of the digits. This so-called multi-frequency dialing method was developed by Bell Telephone Laboratories in 1955.

[8] This begins in antiquity, where several light signs were used side by side to represent a single sign and continues in the history of electrical telegraphy: “Five years earlier, when Wheatstone took out a patent on his first six-wire needle telegraph, in October 1832, Morse, on a voyage from Europe to America on the packet boat Sully, first had the idea of using the properties of an electro-magnet for telegraphy. Morse’s first designs had to be abandoned as impractical; he tried to produce the 26 letters of the alphabet successively through 26, then through 6-3 conducting wires”. (Schellen, op. cit., p. 149 (transl. H. W.)).

[9] The connection had already been recognized at the beginning of the 20th century (cf. e.g. Riepl, Wolfgang: Das Nachrichtenwesen des Altertums. Mit besonderer Rücksicht auf die Römer. Leipzig/Berlin 1913, pp. 100ff).

[10] Cf. again the chapter ‘What does a processor do?’ in my book.

3. nodes

Telegraphy probably represents the most significant turning point in the history of media, because it decoupled the transmission of messages from physical transport for the first time. This applies to the torch telegraphs of antiquity and Chappe's optical telegraph lines;[11] above all, however, to the electric telegraph, which came into the world with Weber and Gauss in 1833. It transmits its messages at nearly the speed of light, revolutionizing the entire space-time structure that governs the flow of information. This profound change was recognized early on.[12]

But talking about 'speed of light', simultaneity etc. is a gross abstraction. It assumes that it is merely about physics and about physical transit times; and as soon as one takes a closer look at the transmission of messages, such idealizations dissolve. Indeed, much more interesting than the physical transit time is the empirical time it takes for the message to reach its actual addressee; and this depends on the construction of the network as a whole, on how many nodes are traversed, on how those nodes are organized, and on the processes of translation required for message transmission. It is amazing how little the media-historical accounts of telegraphy say about this – with the exception of Standage, who undertakes an actual *logistical* reconstruction in one chapter of his rather popular book.[13]

Electricity does not actually rule at the nodes, it is people who hold that position. They have different tasks: They 1.) receive the message – mostly in written form. Depending on the addressee, they 2.) select the telegraph line through which the message is to be sent. This function is notoriously neglected; in fact, however, it is crucial, because only the availability of different lines makes the network a network. They check 3.) whether the line in question is free; then 4.) the message is to be encoded; i.e., the official reads the written text and passes it on to the apparatus with the Morse key. Here, the message is *translated* from the code of writing, which is oriented to human use, into a second one, which follows the necessities of the new transmission technology. This code can be mastered by humans, but it requires a specialization that goes beyond general literacy. This process of translation is of central importance. It mediates between the human and the machine world, and it will become – I anticipate here – the gateway for much more far-reaching automation processes.

At the receiving end, a second official will 5.) translate the message back, either by listening to it, or by reading the log strip. The result is again a written text. This is 6.) delivered to the addressee, in the form of an expedited letter. Here, at the destination, locally, the outdated logic of physical transport by mail still reigns.

---

[11] On the news systems of antiquity, see:
- Riepl, Das Nachrichtenwesen des Altertums, op. cit.;
- Kolb, Anne: Transport und Nachrichtentransfer im Römischen Reich. Berlin: Akademie 2001.
On the optical telegraphs:
- Beyrer, Klaus; Mathis, Birgit-Susann (eds.): So weit das Auge reicht. Die Geschichte der optischen Telegrafie. Frankfurt am Main: Museum für Post und Kommunikation 1995.

[12] "And Science proclaimed, from shore to shore, / That Time and Space ruled man no more." (From the poem 'The Victory' by Rossiter Johnson, written in 1872 in honor of Samuel Morse. Quoted from: Field, Cyrus W.: Laying Of The Atlantic Cable [1866],
http://history-world.org/Laying%20Of%20The%20Atlantic%20Cable.htm; the poem is quoted also in Standage, op. cit. p. 22).
Or: "[T]he natural barriers and obstacles of transport lie in resistances which we can summarize with the words: time and space, i.e. precisely in the conditions in which the earthly, finite nature of human life in general emerges. Every true progress in transportation is therefore always at the same time a successful act of man's inherent restless striving to reduce the barriers of his finite nature, to overcome the time and space in which he must live." "In the nature of those resistances which transportation must overcome, it is of profound significance that heaviness is inherent in persons and material goods as bodies, but not in messages as such. [...] In the transportation of messages, at most the nature of the vehicle comes into consideration, the weight of the packaging in which they are sent over." "The goal was achieved with the invention of electric telegraphy." (Knies, Der Telegraph als Verkehrsmittel [1857], op. cit., pp. 4, 6, 18 (transl. H. W.)).

[13] Standage, op. cit., pp. 92ff.

This representation, however, is also an idealization. It assumes that there is a direct line between sender and receiver; in fact, however, the telegrams had to be forwarded via intermediate stations:

> "The problem arose because most telegraph messages were not transmitted directly from the telegraph office nearest the sender to the one nearest the recipient, but passed via one or more intermediate points *where they were retranscribed and retransmitted each time.*"[14]

If this is taken into account, a much more complex picture emerges; the processes of encoding and decoding multiply, more and more people and more and more translations are involved, and the logic of addressing becomes more complex.

In fact, however, these processes are structurally highly relevant. For example, Standage describes – a very good example – that around 1850 the forwarding of telegrams between the local telegraph stations within London was so costly and time-consuming that they were sent in written form via messengers[15] and then via specially installed pneumatic tube systems.[16]

Locally, therefore, physical transport was *faster* than transmission 'at the speed of light'; for the simple reason that a large number of telegrams could be physically transported at the same time, thus avoiding the telegraphic logic of linear succession.

It is also important that various *media breaks* occur at the nodes. The 'translation' by human operators becomes necessary because the medium is changed: from paper to the electrical signal and vice versa; or from the alphabetic code of writing to Morse code and back. And the same is true for addressing: In the days of telegraphy, only humans were capable of ensuring correct addressing. Standage writes:

> "Each of these offices was a vast information processing center – a hive of activity surrounded by a cat's cradle of telegraph wires, filled with pneumatic tubes. And staffed by hundreds of people [...].
> The layout of a major telegraph office was carefully organized to make the flow of information as efficient as possible. Typically, pneumatic tube and telegraph links to offices within the same city would be grouped on one floor of the building, and telegraph wires carrying messages to and from distant towns and cities would be located on another floor. Grouping lines in this way meant that additional instruments and operators could easily be assigned to particularly busy routes when necessary. International connections, if any, were also grouped.
> Incoming messages arriving by wire or by tube were taken to sorting tables on each floor and forwarded as appropriate over the building's internal pneumatic tube system for retransmission. In 1875, the Central Telegraph Office in London, for example, housed 450 telegraph instruments on three floors, linked by sixty-eight internal pneumatic tubes. The main office in New York, at 195 Broadway, had pneumatic tubes linking its floors but also employed 'check-girls' to deliver messages within its vast operating rooms. Major telegraph offices also had a pressroom, a doctor's office, a maintenance workshop, separate male and female dining rooms, a vast collection of batteries

---

[14] Ibid, p. 92f. (emph. H. W.).

[15] "At busy times, messages might be coming into a particular telegraph office faster than that office could handle them. Instead of being immediately retransmitted, the messages, transcribed on slips of paper, literally started to pile up. [...] Some telegraph companies tried employing additional messenger boys to carry bundles of messages along busy routes from one telegraph station to another - a distance of only a few hundred yards in many cases. *With enough messages in a bundle, this method was quicker than retelegraphing them.*" (Ibd., p. 93 (emph. H. W.)).

[16] "Josiah Latimer Clark [...] proposed a steam-powered pneumatic tube system to carry telegraph forms the short distance from the Stock Exchange to the main telegraph office. [...] Clark first tested the idea in 1853, and by 1854 an airtight tube an inch and a half in diameter had been laid underground between the two telegraph stations. It was capable of carrying up to five messages at once, written on telegraph forms". "By 1865, the increase in traffic had led the Electric Telegraph Company to extend its London tube network and install tube systems in Liverpool. Birmingham, and Manchester. Similar systems were initiated in Berlin in 1865 and Paris in 1866." (Ibid., pp. 94-96).

> in the basement to provide electrical power for the telegraphic instruments, and steam engines to power the pneumatic tubes. Operators working in shifts ensured that the whole system operated around the clock.
> Consider, for example, the path of a message from Clerkenwell in London to Birmingham. After being handed in at the Clerkenwell Office, the telegraph form would be forwarded to the Central Telegraph Office by pneumatic tube, where it would arrive on the 'Metropolitan' floor handling messages to and from addresses within London. On the sorting table it would be identified as a message requiring retransmission to another city and would be passed by internal pneumatic tube to the 'Provincial' floor for transmission to Birmingham by intercity telegraph. Once it had been received and retranscribed in Birmingham, the message would be sent by pneumatic tube to the telegraph office nearest the recipient and then delivered by messenger."[17]

It should be noted, therefore, that the laws governing the nodes are completely different from those that are generally attributed to telegraphy. The lines themselves are electrical, state-of-the-art and fast; at the node, the new medium must rely on traditional media; here, humans rule as translators, using physical sign carriers and the physical transport of signs. My proposal, then, is to understand telegraphy no longer from the line, but now from the nodes.

4. automation of the nodes

It is precisely at this point that the position of the computer in the history of media becomes clear: It is not the individual computer that establishes contact – via telecommunications – with other individual machines, but *with the computer the gaps in the network are grown over, the network conquers its nodes and subjects them to its technical law.*

This is the shift in perspective that my text wants to propose. And there are some indications that support this interpretation. The simplest ones are found within the history of technology itself. The first function to be automated, as already said, was the automatic transcription of the signal onto paper tape. This is found with Morse, unlike his technical predecessors, right at the beginning, that is, as early as 1836. In substance, this means a fusion between transmitting and storing. It had the important consequence that a time-critical task (listening and transcoding) was no longer time-critical. The memory, the paper tape, liberated from the pressure of time and made it possible to streamline the work. The first media break separating transmission and storage was overcome, the technical process chain grew by one link and incorporated the storage function.

The second step was to organize the input via punched tape.[18] Here, too, it is a question of liberating the process from the constraints of time: The production of the punched tape is separated from the input into the transmission channel, so that the input can run at the speed optimal for the technology, which also means a streamlining effect and better utilization of the expensive line. And again, the process chain incorporates a new element; and even more clearly than in the case of transcription on punched tape, insofar as the punched tape involves *machine-readable* characters. The logic of machine readability will have to be examined individually, but it is obvious that the process chain itself develops a logic of its own, and an economic *pressure* that does not seem to tolerate media breaks and gradually pushes them out of the chain.

The code break between the Morse and letter/written alphabet, however, is maintained at this stage. It will only fall with the type printing telegraphs, whose history begins in 1855 with Hughes's telegraph, but which will not become established as the 'Teletype' until the 1930s.[19]

---

[17] Ibid, p. 98f.

[18] Developed in 1858 by Charles Wheatstone (http://www.qsl.net/dk5ke/telegraf.htm).
"Instead of manual operation, the machine telegraphs or high-speed telegraphs use machine operation to transmit the electricity for signaling. The telegrams are first punched into a paper strip in special perforated letters, and the strip prepared in this way is then driven at great speed through the transmitter apparatus." (Lueger [1904], op. cit. (transl. H. W.)).

[19] Cf. ibid. and:
- Weiß, J. J.: Der Typendruck-Telegraph. Winterthur: Hegner 1854, pp. 19ff., online: http://books.google.com,

On the transmitter side, typewriter telegraphs had letter keys so that telegrams could now be entered in plain text. A complicated electromechanical system converted the characters for transmission into pulses;[20] on the receiver side, the device output plain text.[21] Encoding and decoding were now carried out by the apparatus. Morse code was obsolete, and the process chain was two links longer; the front end of the apparatus had moved toward the human and presented an interface in the familiar alphabetic code.[22]

Addressing also proved stubborn as far as automation was concerned. Telegraphy was switched manually; it was not until 1935 that teletypes were equipped with a dial,[23] thus adopting a technology that had been gradually introduced into the telephone network since 1908.[24] With the automatic dialing system, this link in the process chain was also passed on to the machine world.

The latest step in this development, this is my argument, is the computer. As soon as it enters the node, the process chain is finally closed; data and addresses are uniformly formatted, their processing and transmission completely automated; the computer's switching networks can transform the message as well as regulate the switching through to addresses.

And more: It is basically the same logic that organizes the addresses inside the computer case (the control of the components, main memory addresses, ports...) and the geographical addresses outside. The address determines which line is put through; and the case is no more than a 'horizon'. The ports (the connectors) perforate the horizon and the case and connect the inside with the outside.

5. subject theory

My proposal to start not from the individual computer but from the network, and to conceive the computer as the machine that enters and *closes* the gap at the network node, finds a parallel completely outside of technology, in subject theory. Here it was Flusser who proposed the same change of perspective. While the classical subject of the bourgeois Enlightenment saw itself – most clearly in the aesthetics of the genius – as the originator and source of communication processes, and had the illusion of sovereign control over them, Flusser makes it clear that the subject is no more than a node, a kind of relay through which communication passes:

> "The central problem to be discussed with regard to a dialogic society is that of generating information. It is this problem that was called 'creativity' in former times. How do we get information that is unpredictable and improbable? [...] Information is a synthesis of prior information [...]. People are not creators but players with prior information [...].

- Schellen, op. cit., pp. 189ff.

[20] With Hughes, this conversion was time-dependent, so two rotating disks (!) in the transmitter and receiver had to be synchronized again and again. This electromechanical system was considerably more susceptible to failure than Morse's system; this is probably one of the reasons why Morse code was able to last into the Second World War.

[21] For individual machines even with a kind of phototypesetting: "The Buckingham and Siemens & Halske telegraphs directly provide type printing, the former in sheet form, the latter on light-sensitive paper strips through the photographic effect of an electric spark [!]; the last version of the Pollak & Virág's apparatus provides a kind of Latin cursive writing; it is written on light-sensitive paper by a beam of light passed through two oscillating mirrors each connected to a telephone diaphragm." (Meyers Konversationslexikon, keyword: Telegraph: http://de.academic.ru/dic.nsf/meyers/139090/Telegraph (transl. and emph. H. W.)); see also Lueger, op. cit.).

[22] The development of the typewriter telegraph led in 1933 to the *teletype*, an exceptionally widespread and robust system used primarily in the industry, by public authorities and the press. The teletype uses the 'International Telegraph Alphabet', a 5-bit digital code, for transmission. Trial operation in Germany began in 1926; since the eighties, the medium has lost importance, and in 2007 the service was discontinued in Germany.

[23] Cf: Wagner, Oskar A.: Vom Drucktelegraphen zum Telex-Netz. In: PCNews, No. 74, 8/20/2001, http://pcnews.at/?Id=1089&Type=Htm.
Image: http://upload.wikimedia.org/wikipedia/commons/0/0b/Telex.jpg.

[24] "1908, first Telephone dial system local network Hildesheim in Germany." (Anonymous: Geschichte der Telekommunikation von 1833 bis 1944, http://waehlamt.at/nte2/history/g1-frameset.htm). Hand switching operated by German Telekom was not irrevocably terminated until 2003.

> [T]he so-called 'I' forms a nexus point in a web comprising streams of information in dialogue, storing information that has passed through. This is in fact the case for both inherited information and for the overwhelming majority of that which is acquired. At this nexus point, unpredictable, improbable computations occur, new information."[25]

Subsequently, the subject owes everything it is to communication, the network and the media.

> "If one regards the 'I' as a nexus point in a dialogical web, society necessarily appears as a superbrain made up of individual brains. And the telematic society would distinguish itself from earlier societies only insofar as its cerebral-net character has become conscious, enabling us to start consciously manipulating the net structure."[26]

The metaphor of a social 'superbrain' is certainly debatable. The figure of thinking of the subject no longer as autonomous but now as dependent, as a relay, is one that Flusser derives from the French subject-critical philosophy of the 1960s, which he attempts – one might say – to ground in a media-materialist way.

For Flusser, this change of perspective has several consequences: Thus, communication is no longer a secondary function, added quasi luxuriously to a self-referential and self-sufficient subject, but primary in every sense.[27] Secondly, for its suchness, its identity, the node is made completely dependent on the communications that have passed through it and given it its form. Communication, its rules and requirements, structure the node. This motif, too, comes from French subject philosophy, more precisely from the arguments concerning the 'linguistic turn', the insight into the central role of language, which constitutes people as linguistic beings, and at the same time subjects them to language.

But how can this parallel come about? Isn't it about technology in one case and ~~humans~~ about human beings in the other? Considering that the subject theory tries to clarify the position of humans, but the argument here aims at the nodes of telegraphy, and the role of computers in these nodes? And more: Was it not said that the development of technology increasingly *closes* the process chain, which is to say: *displaces* the acting humans from the process chains?

It will be necessary to realize that both Flusser and subject theory already frame their question with media in mind. If it is the networks of communication and language – i.e. cultural techniques – that define the position of the subject, then subjects and technique are not separated by an abyss. The assertion is accordingly not one of substitution. The thesis would rather be that the network precedes the nodes, that there are *laws* in the space of communication that apply to machines as well as to people.

6. machine readability

Let's return to the level of technology. The crucial point of the punched tape, as has been said, is that its writing is readable by machines. Now, machine readability is indeed a linchpin for the argument pursued here – and for computers and telecommunication in general; and it has been almost universally passed over by media studies as well as by computer science.[28]

Machine readability initially means that a piece of information can be passed from one device to another. Wikipedia defines it rather carelessly:

> "Machine-readable medium: In telecommunication, a machine readable medium (automated data medium) is a medium capable of storing data in a machine-readable format

---

[25] Flusser, Into the Universe of Technical Images, op. cit., pp. 87-91.

[26] Ibid, p. 92.

[27] Here, despite all differences, we can find a parallel to Luhmann, who bids farewell to the acting subject – until then certainly a cornerstone of sociology – and declares 'communications' to be the basic building block of society.

[28] To my knowledge, there is neither a monograph dedicated to this topic, nor does the keyword appear – with the exception of the English edition of Wikipedia – in the relevant encyclopedias. The same is true for most of the introductions to computer engineering. At the same time, the adjective is frequently used, e.g. in the context of RFID or barcode, as if it were unnecessary to define the term...

> that can be accessed by an automated sensing device and capable of being turned into (practically in every case) some form of binary."[29]

Machine readability is subject to various technical conditions: There must be a technical carrier that can guarantee the identity and stability of the signal; this applies to stored signals as well as to signals processed in real time. The signal must remain within predefined technical limits, which requires strict standardization;[30] the signal must be unambiguous as a signal; and there must be a code that is shared by the transmitting and receiving devices. In addition, a certain complexity of the used code is needed, insofar as one would not speak of machine readability for individual switching pulses with which one device controls another.

Further, there is an implicit reference to the code of writing, insofar as machine readability requires distinct characters: A fax machine, to give a counterexample, controls the receiving device via telecommunications by means of complex control signals; since it is an *image* that is transmitted, and the machine does not know the transmitted letters, it is not a case of machine readability; cell phone signals are machine-readable only at the level of digitally transmitted bits, but not in terms of linguistic articulation; telegraph and teletype, and even a loom controlled by punched cards, process machine-readable data.

Machine readability belongs to the problem area of *technical reproduction*.[31] And finally, machine readability concerns only the level of the signal, thus it does not imply the dimension of meaning. 'Reading' and 'readability' are metaphors in this respect. Machine readability is the prerequisite for interconnecting the devices of telegraphy into a 'process chain' in the first place. This is particularly evident in those nodes that serve as hubs for forwarding the telegrams. Originally, as mentioned, the text had to be written down, re-transcribed and then forwarded each time. It was not until the high-speed telegraphs of Murray [1899] and Creed [1902] that a change was made here, in that the same punched stripes as were needed for the input could now also *be output* automatically at the destination: "The recording stripe accurately reproduces the punched writing of the transmitting stripe; *in transit, it can therefore be reused immediately as a transmitting stripe"*.[32]

This was the decisive step towards the *continuous flow of data*, towards which telegraphy – as towards an implicit telos – is continuously heading. And now I come back to my thesis: Only machine readability makes it possible to overcome the media and code breaks that had characterized the nodes of telegraphy until then, and to displace people from the nodes step by step. With the computer, this development comes to an end.

7. conclusion

The computer, as I have written elsewhere,[33] is a medium insofar as it draws the most radical consequence from the logic of telecommunications: The computer derives its peculiarity from the fact that it fuses the space of telecommunication with the inner workings of the machine.

Media history can be understood as a process of increasing immaterialization. If at the beginning communication concerns those that are present, then with pictures, monuments and writing, the signs finally detach themselves from the bodies. What is striking here is that the sign carriers, the signifiers, become smaller and lighter. From the monumental inscriptions to the clay tablets to the comparatively light paper, a process takes place that consumes the materiality of the sign carrier (the substance of the signifiers) step by step. The motor of this development, of course, is the transport of signs: Signs want to circulate, and this is all the more possible if the inertia of mass they have to overcome gradually decreases.

---

[29] http://en.wikipedia.org/wiki/Machine-readable.

[30] ... if a certain electrical impulse is expected, a tenfold stronger one would certainly be problematic ...

[31] It would certainly be interesting to flesh out that connection.

[32] Lueger, op. cit. (transl. and emphasis H. W.).

[33] Cf: Winkler, Hartmut: Medium Computer. Zehn populäre Thesen zum Thema und warum sie möglicherweise falsch sind. In: Engell, Lorenz; Neitzel, Britta (eds.): Das Gesicht der Welt. Medien in der digitalen Kultur. Munich 2004, pp. 203-213, the first part of my summation is preformulated there.

The crucial point is reached with telegraphy: In 1840, signs were detached from physical transport and could then be sent 'immaterially' through wires as well. All electronic media expand this possibility.

The computer now, this is the crux of my argument, draws the conclusion from this process. It establishes a continuum between the modes of transmission, the modes of storage, and the possibility to process/permutate signifiers. In all other media, these modes fall far apart; books are produced by means other than distribution and storage, and even a CD must still be physically transported if it is to circulate. Only the computer creates a continuous process chain here, similar to the way the assembly line in industry links the heterogeneous individual processes into a chain.[34] This is the reason why *machine readability* had to be emphasized. Only when the characters are machine-readable does this new quality occur.

So it is the logic of telecommunication – the logic of transport and sign circulation – that gains power here also over the inner structure of the machine. Inside the computer, telegraphy rules: Signifiers are sent back and forth, stored and processed/permutated. In this way, the initial thesis also gains plausibility: Computers are not a medium because they are wired, but the other way around: Because it is a child of telegraphy, the computer forces wiring. It forces to connect its inner telegraphy to the outer telegraphy; the space *between* the digital single machines and the space *within* these single machines are structurally always already similar. Confined to the flow of signifiers, it is really about transmitting, storing, and processing. And everything new that the computer offers as a *medium* lies on this terrain. Sign transport and telecommunication put their stamp on the signs themselves. The computer emerges as a result of telegraphy; as a medium, a node in the network of sign circulation.

The second idea of my summation concerns the distinction between micro and macro. If the computer is a local microstructure, enclosed in a case, and telegraphy is a geographically distributed macrostructure, then my thesis implies that there is a double connection between the two: On the one hand, a *structural homology*, insofar as the same basic functions occur at both levels – transmitting, storing; reading, writing; addressing... –, with the consequence that one can describe micro and macro in terms that are compatible. And secondly, beyond this correspondence, the computer creates actual integration. Since the Internet has been established – and that means: since the computer has conquered the network nodes and taken its position there – it no longer makes a substantial difference whether the processor sends data to the local hard disk or to a server on the other side of the globe. The threshold between micro and macro has been leveled; both are *functionally integrated*.

Finally, my last point concerns addresses. If transmission and storage are the central functions, inside the computer as well as on the macro level of telegraphy, then the address has a prominent position. The address is an ordering system that structures space (at the macro level of geography as well as at the micro level of the individual memory[35]), it specifies the target point for transmission operations, and if it is available in machine-readable form, it is executable, i. e. it becomes part of an instruction that can be executed by automata.[36] In this respect, addresses are instances that mediate between the static of the space (and the memories) and the processual transfer procedures.

And even more: On the one hand, addresses have a special status; as metadata, they are glued to the message like the address label on an envelope. On the other hand, computers have the astonishing capability of treating addresses exactly like data: Addresses are not only transmitted and stored in parallel with data (the 'message'), they are also processed like the latter, i.e. constantly converted and translated.[37] Both, their positioning at the precarious interface between

---

[34] The various references to "automation" invoke a larger context: It would be necessary to show how the traffic of goods/logistics and sign traffic are actually connected, and at what points they follow a comparable development logic and – think of rationalization – comparable economic constraints. In my book 'Economics of discourse' I have given some thoughts on this (W., H.; Diskursökonomie. Frankfurt am Main: Suhrkamp 2004).

[35] Cf. my chapter 'What does a processor do?'

[36] This connection between the command logic of programming languages and the automation of the address function would also merit further consideration.

[37] Ibid.

stasis and process (space and time) and their ambiguous status as data and metadata have hardly been considered so far.

I think that a new perspective does indeed emerge from what has been said. If the computer – as can be seen from the details of its construction – is not a stand-alone device, but a child of telegraphy; if it enters the nodes of the network and closes the gaps as well as the media breaks there, which until then required humans as 'translators'; if it creates a *continuous flow of data* together with telegraphy, then this could be the actual, qualitative leap. Flusser has tried to capture this leap with the concept of a 'telematic society'. Whether this has the character of a 'cerebral network' remains to be seen; rather, it seems as if machine readability and continuous flow of data place human users in a position similar to that of observers.

One thing is clear: *the computer makes certain mechanisms of communication visible for the first time*. This only becomes clear when we look at telegraphy. Like telegraphy itself, it can be seen as a machine that reenacts certain features of communicative practices by mimetically reproducing them and giving them a technical form. The fact that the computer reduces them – ambiguously – to the mechanical, and at the same time increases/multiplies and expands them, is what makes this mirror so difficult to comprehend.